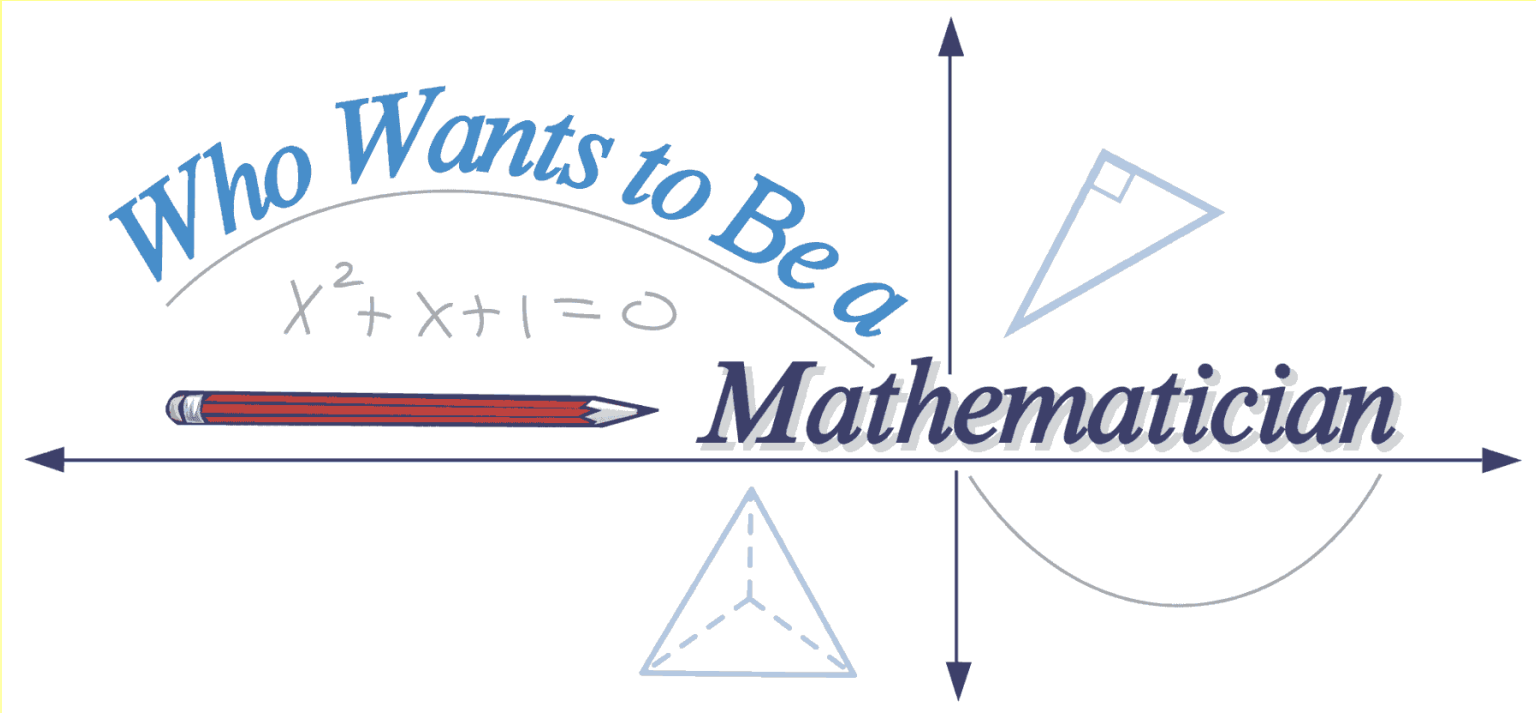


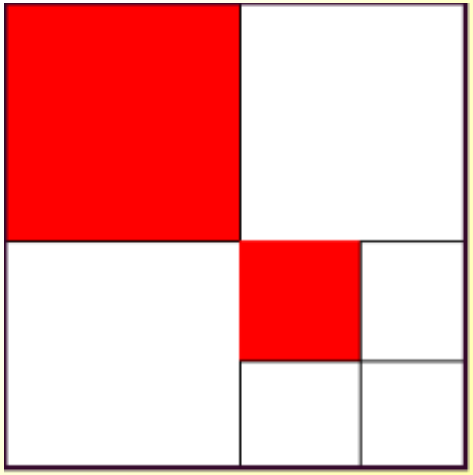
φØs

60

Question #1—1000 Points

A unit square is divided into four equal subsquares and the upper left one is colored red. The lower right subsquare is then divided into four equal smaller subsquares and the upper left one is colored red. This dividing and coloring process continues forever on the lower right subsquare constructed at each step. How much area of the original square is colored red?

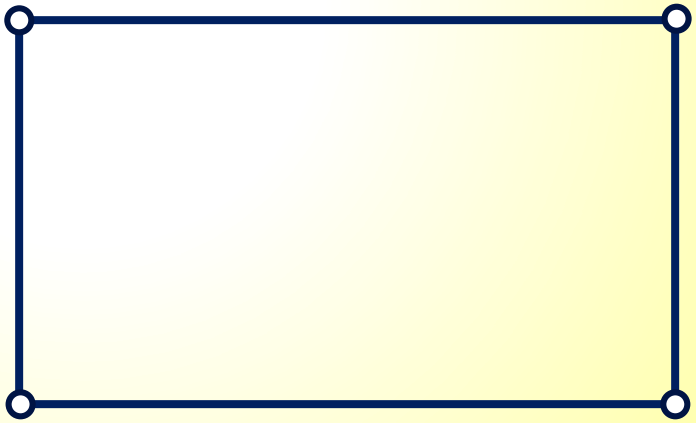
A. 1/4
B. 5/16
C. 1/3
D. 5/12
E. 1/2



Question #2—1000 Points

How many ways are there to assign colors to the vertices (nodes) of the graph below using white, green, red, and blue, if two vertices that are connected by an edge (line) must use different colors? Note: all colors need not be used in a coloring.

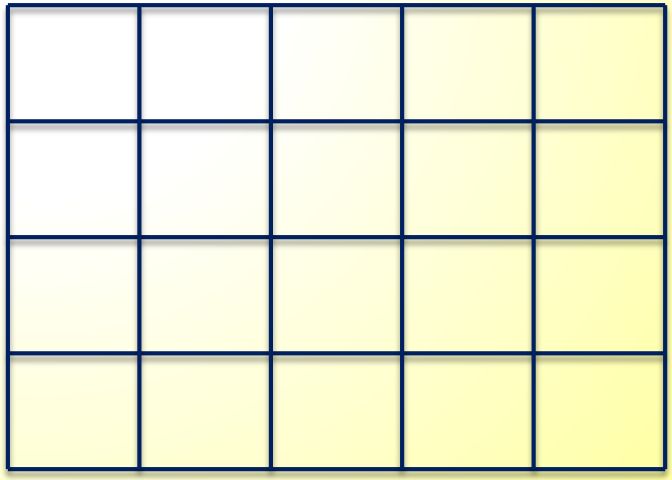
A. 48
B. 60
C. 72
D. 84
E. 144



Question #3—2000 Points

Consider a 27 × 21 rectangle subdivided into unit squares (5 × 4 version shown below). How many unit squares does a diagonal drawn from the lower left corner to the upper right corner pass through? (To pass through a unit square the diagonal must contain interior points of the square.)

A. 27
B. 36
C. 42
D. 45
E. 48



Question #4—2000 Points

Which of the following mathematicians did not win a Fields Medal?

A. Timothy Gowers
B. John Nash
C. William Thurston
D. Edward Witten
E. Maryam Mirzakhani

Question #5—3000 Points

Travis cashes his lawn-mowing check at a bank where the absent-minded teller switches the dollars and the cents. Travis then buys an ice cream for 50¢ and has left twice the amount of the original check. The amount of the original check was:

A. less than $10
B. between $10 and $15
C. between $15 and $20
D. between $20 and $25
E. more than $25

60

Question #6—3000 Points

Which of the following is largest?

A. $\tan\frac{\pi}{7}+\cot\frac{\pi}{7}$

B. $\sin\frac{\pi}{7}+\cos\frac{\pi}{7}$

C. $2\tan\frac{\pi}{7}+\cos\frac{\pi}{7}$

D. $2\sin\frac{\pi}{7}\cos\frac{\pi}{7}$

E. $\sqrt{2}\sin\frac{\pi}{7}+\cot\frac{\pi}{7}$

60

Question #7—5000 Points

What is the sum of the squares of the roots of $2x^3 - 11x^2 + 38x - 39$?

A. $-45/2$

B. $-31/4$

C. $45/4$

D. $45/2$

E. 45

$$2x^3 - 11x^2 + 38x - 39 \;\rightarrow\; x^3 - \tfrac{11}{2}x^2 + 19x - \tfrac{39}{2}$$

If r, s, and t are the roots, then

$$(r+s+t)^2 = r^2 + s^2 + t^2 + 2(rs + rt + st) = \left(\tfrac{11}{2}\right)^2$$

$$r^2 + s^2 + t^2 + 2(19) = \tfrac{121}{4}$$

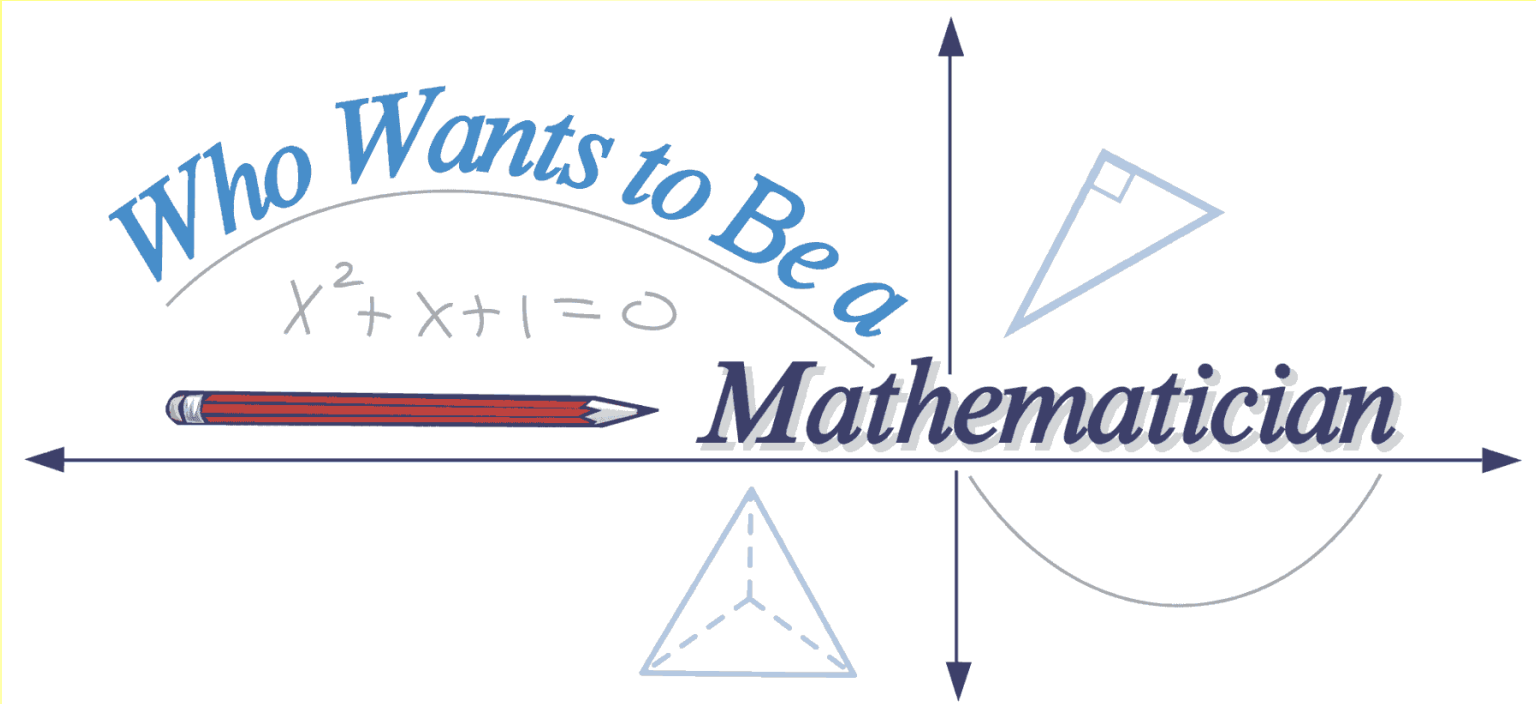
$$r^2 + s^2 + t^2 = \tfrac{121}{4} - 38 = -\tfrac{31}{4}$$

Polynomial Long Division and Root Power Sums,
Dan Kalman and Stacy Langton, **Horizons**,
February 2014

Question #8—5000 Points

The earliest appearing four-digit number in Pascal's triangle is 1287, which is $C(13, 5)$. What is the earliest appearing five-digit number in Pascal's triangle?

A. 10,000
B. 10,720
C. 11,380
D. 11,440
E. 12,870



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